7 Management to Protect the Natural Landscape on DCR/DWSP Property

7.1 Biodiversity Mandate

Congress passed the Endangered Species Act in 1973 to provide federal protection for 292 declining species, and began to legally define the national commitment to maintaining biodiversity in the process. The ESA specifically protected 27 plant and animal species in Massachusetts, and provided both the impetus and funding to restore popular species such as peregrine falcons and the bald eagles in the state. Subsequent to the passage of the ESA, Massachusetts has added additional statewide legal protection for biodiversity. Both MGL ch. 131 (the Wetlands Protection Act) and ch. 132 (the Forest Cutting Practices Act) require regulatory bodies to consider impacts on habitat and species during proposed development or management activities. Massachusetts passed its own Endangered Species Act in 1990, providing protection currently for 424 plant and animal species. This act provides regulatory protection for significant habitats of the listed species, as well as direct protection for the species.

In recent years, the protection of biodiversity has become a high priority for state agencies in Massachusetts. Massachusetts is a diverse environment that currently supports at least 15,000 native species of plants and animals (including about 12,000 insects). MassWildlife (previously the Division of Fisheries and Wildlife) currently operates the Natural Heritage and Endangered Species Program, the goal of which is to protect the state's native biological diversity. MassWildlife also recently launched the "Biodiversity Initiative," in order to coordinate two new programs that were created by the 1996 Open Space Bond Bill (Chapter 15, Acts of 1996). These programs include the Ecological Restoration Program and the Upland Habitat Management Program. The Ecological Restoration Program's major goal is to "focus future restoration action on the fundamental problems threatening biodiversity, including the restoration of natural processes and native community composition." To achieve this goal, the Ecological Restoration Program intends to follow the following strategies:

- Conserve species before they become rare by protecting their habitat.
- Restore natural processes that sustain biodiversity at key sites.
- Limit invasion by exotic or invasive species.
- Replicate natural processes, where they cannot be maintained or restored, at appropriate times, places, and in justifiable quantities.
- Consider species reintroduction only when species' requirements and causes of extirpation are sufficiently understood, and carefully consider the costs and benefits.

The Natural Heritage Program, in conjunction with the Massachusetts Chapter of The Nature Conservancy published "Our Irreplaceable Heritage: Protecting Biodiversity in Massachusetts" in 1998. This document outlines a Biodiversity Protection Strategy that includes the following:

- Encourage all conservation agencies, land trusts, municipalities, and not-for-profit conservation organizations to increase the importance given to and financial support for the conservation of uncommon and under-protected components of biodiversity.
- Educate landowners about maintaining and restoring certain natural processes and minimizing disturbance.
- Aid land managers in implementing land management techniques that mimic natural processes where they cannot be maintained or restored.

- Strive to achieve an equitable distribution of biologically viable conservation lands at all topographic elevations and across all ecoregions.
- Take action to conserve natural communities and species that have experienced tremendous loss or are under considerable threat.
- Focus attention on common or rare natural communities and species that are under-protected.

The April 2000 "The State of Our Environment" report from the Massachusetts Executive Office of Environmental Affairs (EOEA), acknowledged the link between human needs and healthy, thriving natural communities. EOEA identified loss of habitat through development, and invasive species as the two most distinct threats to maintaining natural diversity in Massachusetts, and further committed to preserving biodiversity through the identification and protection of critical habitats and the creation of bioreserves that will include central cores of public land. Specific to public forestland, EOEA has completed a Forest Vision Project that sets priorities for a biodiversity-based management approach, and is currently working to develop landscape-level guidance documents for each ecoregion in the state, as part of sustainability certification of all state forest management.

DCR Division of Water Supply Protection mandates (stated in MGL ch. 92) and Special Acts of the Legislature (including c. 372 of 1984, and c. 737 of 1972) are directed at the production and protection of high quality drinking water for metropolitan Boston. However, these laws also set forth a broad commitment to the protection of natural resources and species diversity. Chapter 737 addresses the management of Quabbin and Ware River Watersheds, and includes the following broad mandates:

> Section 2: The natural ecology of the district shall be maintained and it shall be conserved in the present degree of wilderness character...[it] shall be protected in its flora and fauna in all reasonable ways…no act shall be undertaken which will adversely affect the balance of nature…
>
> Section 8: Lumbering or logging operations shall be permitted…to the extent and for the purpose of maintaining and conserving its forests in a healthful state of natural ecological balance consistent with reservoir and watershed purposes…

The Division's principal goals for maintaining biodiversity on its Ware River watershed holdings are to retain most of these lands in a forested condition, to identify and provide habitat for the protection of uncommon and rare flora and fauna, to eliminate and prevent the spread of non-native invasive species, and to provide the range of seral stages from early-successional habitat through unmanaged mature forest.

7.2 Rare Natural Communities

A natural community is a combination of physical and biotic conditions that form a functionally distinct area of the landscape. An area's physical conditions (topography, hydrology, geology, etc.) will determine the vegetative composition, which in turn will dictate the type of animal community that lives there. Ideally, to adequately protect and enhance these communities, all features of the system must be properly protected and enhanced, not just individual parts.

Natural communities may be rare or uncommon globally, statewide, or at a local level. To ensure all rare communities receive adequate protection it is necessary to know where the communities are located on the landscape. Unfortunately, the Division has little information regarding rare or exemplary communities within the Ware River watershed. Some communities (e.g., vernal pools) are known and documented. In addition, the NHESP has limited records of rare species or communities known to occur

on the watershed. Still, most communities considered rare or exemplary on a local or regional level have not been mapped.

The Division's first step in managing rare natural communities will be to properly classify rare, unique, and exemplary communities that may occur within the watershed. When the classification system has been established, mapping can begin to locate potential communities. Field inspections will then be required to verify mapped areas. Management will be modified as needed to maintain the integrity of the area.

A project to map rare, unique, and exemplary natural communities was recently conducted on the Quabbin Reservoir watershed. A classification system tailored to Quabbin communities was developed and preliminary field verifications were conducted. Mapping and management recommendations for each community were completed. Some information from the Quabbin study can be utilized at the Ware River, since many of the communities are rare or unique on a statewide or regional level. For example, talus slopes, pitch pine-scrub oak, hemlock ravines, tupelo swamps, vernal pools, and peat wetlands, identified as rare communities at Quabbin also occur on the Ware River watershed. A complete census of Division land is necessary to accurately inventory community types.

7.3 Rare and Endangered Species

7.3.1 Fauna

Division property within the Ware River watershed is home to a number of state-listed vertebrate species (Table 16). However, because the Division's land holdings are protected from development, it is possible that past rare animal surveys bypassed Division land. Thus, it is likely that there are additional undiscovered populations of rare and endangered species on Division property. In fact, most documented rare species within the Ware River watershed have not been observed on Division property. Although land protection is the most critical factor for survival, it would be very helpful to know where these species are located. The Division does actively manage its landholdings, and therefore there is the potential for these activities to have negative impacts on rare species. In addition, some species may require additional management in order to enhance or modify existing habitat to benefit their survival.

In order to ensure that land management activities do not disrupt or destroy listed species or their habitats, an accurate and current species occurrence database must be available and expanded. The Division biologists keep records of listed species on Division land that were discovered by in-house personnel or by the general public. The state's Natural Heritage and Endangered Species Program has much more complete and detailed databases of listed species. In some cases, land management activities carried out by the Division (e.g., Ch. 132 forest cutting plan) are reviewed by NHESP. Other activities, such as routine maintenance (mowing, brush cutting) or watershed maintenance activities (road building/repair) are conducted without a requirement to notify NHESP. In these situations, it is possible to unknowingly and negatively impact rare or endangered species. Again, this points to the need for additional rare species surveys (see Section 6.3), particularly on recently acquired parcels where little is known about the land.

In many cases, species become rare because of loss of habitat. One of the greatest benefits of Division land to wildlife is that it will remain in a natural state and not be developed. A majority of this habitat will be covered by forest. This is a benefit to rare or endangered species requiring forested habitat (e.g., sharp-shinned hawk, Cooper's hawk) but will not help other species that require different habitat, such as fields (e.g., bobolink, Eastern meadowlark). Approximately half the species listed in Table 16 are

either dependent on wetlands or utilize them during some portion of their lives. Protecting and maintaining functioning wetland systems is a priority for the Division, and this priority should benefit wetland species. In addition, vernal pools on Division land receive particular attention and protection (see section 6.3.1). Current MA BMPs for vernal pools are being studied to determine their effectiveness in protecting vernal pool dependent species.

Non-forested upland habitat is much rarer on Division property and is limited to maintained open fields. There are several species on Table 16 that require open fields or meadows. Although the Division will not create field habitat, it does recognize the importance of this habitat in the landscape. Therefore, where feasible, the Division will maintain and enhance this habitat on select portions of its land (see Section 7.5.3).

Areas with highly disturbed soils represent important habitat for several species listed in Table 16. There are several large, active and inactive gravel and sand pits on Division land, as well as areas of stream and shoreline erosion, and abandoned industrial/residential land. Wood and box turtles use sandy or gravelly areas to lay their eggs. In addition, some invertebrates, such as the big sand tiger beetle, dune ghost tiger beetle, oblique lined tiger beetle, frosted elfin and hoary elfin, utilize areas of highly disturbed soils. The Division recently documented wood turtles laying eggs in an abandoned Division sand pit. In many cases, however, these highly disturbed areas are scheduled for restoration. The Division recognizes the potential wildlife value some of these areas have, and in the future the Division will examine each site on a case-by-case basis to determine actual erosion threat, and habitat suitability for selected wildlife species. In some cases, where erosion is not a threat, the site can be abandoned and left in its disturbed state.

Some species listed in Table 16 are assisted by habitat protection, but still need additional assistance to successfully breed. In these cases, when personnel and resources allow, the Division may provide the needed breeding structures or other conditions. When possible, the Division may provide nesting boxes for long-eared owls, and erect nesting structures for bald eagles.

7.3.2 Flora

Primary responsibility in Massachusetts for the protection of endangered, threatened, or special concern plant species rests with the Natural Heritage and Endangered Species Program of the Department of Fish and Game. NHESP has identified 257 species of plants in these categories across the state, and is working continually to design effective protection strategies. Regulatory support for these efforts exists at both the federal and the state level. The Federal Endangered Species Act of 1973 protects 292 species of national significance, which includes the small-whorled pogonia (*Isotria medeoloides*) that is found in Massachusetts. Additional protection was provided by the 1990 Massachusetts Endangered Species Act, which protects a total of 424 species, of which 250 are plants.

Plants are considered rare for a variety of reasons. In some cases, it is simply that Massachusetts is at the northern limit (e.g., Black maple, *Acer nigrum* or River birch, *Betula nigra*) or the southern limit (e.g., Dwarf rattlesnake plantain, *Goodyera repens* or One-flowered pyrola, *Moneses uniflora*) of their range. For species that are generally associated with the eastern deciduous forest, which dominates central and western Massachusetts, plants may be rare simply because they are poor colonizers and thus populations remain widely scattered and sparse. Loss of habitat is also a common cause of plant species loss. Bruce Sorrie, former Massachusetts state botanist, estimated that a surprising 72% of the species extirpated from the state had been lost due simply to the loss of early-successional or recently disturbed habitat (Sorrie, 1989). Karen Searcy, current curator of the University of Massachusetts herbarium,

reported in 1995 that 13% of the rare species likely to occur on Division properties rely on early-successional habitat or disturbance such as fire to persist (Searcy, 1995). Animal populations are

TABLE 16: STATE-LISTED VERTEBRATE SPECIES IN THE WARE RIVER WATERSHED

SPECIES	STATUS[1]	OCCURRENCE[2]
AMPHIBIANS		
Blue-Spotted Salamander	SC	Probable
Marbled Salamander	T	Probable
Spring Salamander	SC	Probable
Four-Toed Salamander	SC	Documented
Eastern Spadefoot	T	Potential
REPTILES		
Spotted Turtle	SC	Probable
Wood Turtle	SC	Documented
Blanding's Turtle	T	Probable
Eastern Box Turtle	SC	Documented
Copperhead	E	Historic
Timber Rattlesnake	E	Historic
BIRDS[3]		
Common Loon	SC	Potential
Pied-Billed Grebe	E	Potential
American Bittern	E	Documented
Least Bittern	E	Potential
Bald Eagle	E	Potential
Northern Harrier	T	Potential
Sharp-Shinned Hawk	SC	Probable
Cooper's Hawk	SC	Probable
King Rail	T	Potential
Upland Sandpiper	E	Historic
Common Barn Owl	SC	Historic
Long-Eared Owl	SC	Probable
Short-Eared Owl	E	Historic
Sedge Wren	E	Historic
Golden-Winged Warbler	E	Historic
Vesper Sparrow	T	Probable
Grasshopper Sparrow	T	Probable
Henslow's Sparrow	E	Historic
MAMMALS		
Water Shrew	SC	Probable
Southern Bog Lemming	SC	Probable

[1] Species status in Massachusetts: SC= species documented to have suffered a decline that could threaten the species if allowed to continue unchecked; T = species likely to become endangered within the foreseeable future throughout all or a significant portion of its range; E = species in danger of extinction throughout all or a significant portion of its range.
[2] Occurrence of species on Division land within the watershed: Documented =species actually observed; Probable =species not documented, but given available habitat, species' range, and/or observations within the watershed, they are likely to occur; Potential =species not documented, and current habitat conditions may not be suitable, but with habitat enhancement they may occur; Historic= species not documented, and current or future habitat conditions are not likely to support these species.
[3] Occurrence of birds is limited to breeding pairs, not migratory or seasonal residents.

responsible for some losses, either through heavy browsing or through dramatic habitat alterations such as those caused by beaver. While beaver wetlands may provide habitat for some rare plants, they also flood bogs and other uncommon habitats that may have contained rare plant populations. Some species (e.g., Ginseng, *Pallax quinquefolius* L.) have declined directly because of over-collecting. Invasive, non-native plants have also been implicated in the decline of some uncommon native species.

Management recommendations for protecting rare plant populations begin with efforts to identify current populations. The Division is committed to working to locate these populations and adding them to GIS databases so that they will appear on maps even at times when they are difficult to locate in the field. Several agencies and organizations, including the NHESP in Massachusetts and the Southern New England Forest Consortium, are working to develop specific management recommendations for the perpetuation of uncommon plant species. Much remains to be learned about the specific light, moisture, and regeneration requirements for the species of concern. Some species will persist best if given a wide berth, while others benefit from periodic disturbance. The Division will rely on recommendations being developed to guide management practices around known rare plant populations. For instance, the Southern New England Forest Consortium has recently published "Rare and Endangered Species: Field Guide for Southern New England," which includes management recommendations. The Division will continue to work to identify rare plant populations and to research and apply management recommendations for their protection.

7.4 Biotic Invasions

7.4.1 Definitions

The following definitions are taken from President Clinton's "Executive Order 13112 of February 3, 1999 – Invasive Species."

"Alien species" means, with respect to a particular ecosystem, any species, including its seeds, eggs, spores, or other biological material capable of propagating that species, that is not native to that ecosystem.

"Control" means, as appropriate, eradicating, suppressing, reducing, or managing invasive species populations, preventing spread of invasive species from areas where they are present, and taking steps such as restoration of native species and habitats to reduce the effects of invasive species and to prevent further invasions.

"Ecosystem" means the complex of a community of organisms and its environment.

"Introduction" means the intentional or unintentional escape, release, dissemination, or placement of a species into an ecosystem as a result of human activity.

"Invasive species" means an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health.

"Native species" means, with respect to a particular ecosystem, a species that, other than as a result of an introduction, historically occurred or currently occurs in that ecosystem.

"Species" means a group of organisms all of which have a high degree of physical and genetic similarity, generally interbreed only among themselves, and show persistent differences from members of allied groups of organisms.

Current research in the field of invasives has documented that animal invaders can cause extinction of native species through habitat alteration, predation, and competition (Mack et al., 2000). Further, plant invaders can completely alter the nutrient cycling, hydrology, and energy budgets in native ecosystems, thereby affecting the abundance or survival of native species (Mack et al., 2000).

Although there are several examples of invasive animals present on the Ware River watershed (e.g., gypsy moth), there are many more invasive plants know to be present, and these represent the greatest immediate risk to native habitats and species. Therefore, DCR/DWSP efforts in controlling invasive species will focus on the control of invasive plants during the next 10 years.

"Invasive" plants fall into at least two categories – native or non-native species. Most of the difficulties associated with invasive plants involve plants that are non-native. This is true in part because these non-native "aliens" have been transported out of the ecosystem in which they evolved, and may have escaped specific population-controlling insects and diseases in the process. It is important to point out that not all non-native plants are invasive. Most have been intentionally introduced into agricultural or horticultural environments, and many are unable to reproduce outside of these intensively managed environments. There are, unfortunately, hundreds of others that were introduced either deliberately or accidentally to natural settings and have managed to aggressively force out native plants, raising serious biodiversity issues, and potential threats to water quality protection.

Some of the invasive plant problems on Division properties are the result of deliberate plantings that initially addressed other concerns, for instance, planting autumn olive to improve wildlife habitat. Other invasive species are escapees from landscaping that predates Commonwealth acquisition of watershed properties, including Japanese barberry, Japanese knotweed, the buckthorns, and purple loosestrife. Several qualities contribute to a plant's "invasiveness":

- The plant grows and matures rapidly in abundantly available habitats.
- It is capable of producing vast quantities of seed that is easily dispersed by animals, and often can also reproduce vegetatively.
- There are no diseases or pests effectively controlling its reproduction and spread (which generally means there are no close relatives in the habitats it invades).
- The plant does not require intensive management to thrive.

Japanese barberry, Berberis thunbergii

7.4.2 Problems Associated with Invasives

The 2000 EOEA report "The State of Our Environment" states that "the two biggest threats to biodiversity in Massachusetts are the destruction and fragmentation of wildlife habitats and the introduction of invasive non-native species." The Nature Conservancy has reported that 42% of the declines of threatened or endangered species in the US are partly or wholly due to the effects of invasive species. Some of these threats are subtle. For instance, when the declining West Virginia white butterfly lays its eggs on the invasive garlic mustard instead of on the usual native mustards, its eggs fail to

develop. Other threats are more obvious. For instance, purple loosestrife currently covers an estimated 500,000 acres in northern US and southern Canada, displacing native food sources and threatening to prevent successful nesting in 90% of the wetlands used by breeding waterfowl along the Atlantic and Mississippi flyways. Impacts from invasives on the soil and its faunal community have also been documented. There is evidence that a Chinese tallow tree is altering nutrient cycling where it invades, causing a decline in the native soil invertebrates as a consequence.

Resilient plant communities are important to watershed management for controlling the erosion of soil and nutrients following a range of natural disturbances (e.g., droughts, insect outbreaks, fire, wind, heavy snow and ice). Resilience is partially dependent upon species and size diversity in the plant community, because disturbances are frequently species and/or size specific. When plants become aggressively invasive, they replace the diverse native flora with local monocultures, thereby decreasing the diversity and associated resilience of the community. The prevention of forest regeneration by certain aggressive invasives has become a problem on some areas of the watersheds. Around the Quabbin Reservoir, Japanese barberry that was planted on historic home sites took advantage of high deer populations (which do not feed on barberry) to colonize and monopolize the understories of significant forest areas. At the Wachusett Reservoir, autumn olive has aggressively occupied open fields, delaying or precluding their return to forest cover. Buckthorns are replacing native understory vegetation in some areas on the Ware River watershed. Invasives are often more effective than natives in colonizing disturbed areas, and may overrun young trees that do become established. Table 17 lists invasive plants that are known to be present on the Ware River watershed.

Common buckthorn, Rhamnus cathartica

7.4.3 Management Options

The ultimate goal of an invasive species control program may be to eradicate the non-indigenous species from the region of concern. Eradication is sometimes possible, especially if the species is detected early and attacked quickly. Three factors seem to influence whether an eradication program will be successful (Mack et al., 2000). First, the biology of the target species must be susceptible to control. Second, sufficient resources have to be devoted for a sufficient period of time. Changes in funding levels before the program is complete make eradication impossible. Finally, eradication requires support from both the public and the managing agency.

TABLE 17: INVASIVE PLANTS PRESENT ON THE WARE RIVER WATERSHED

Common Name	Latin Name	Habitat
Black locust	*Robinia pseudoacacia*	Edge of forest/field
Norway maple	*Acer plantanoides*	Forest
Oriental bittersweet	*Celastrus orbiculata*	Forest
Japanese barberry	*Berberis thunbergii*	Forest
Shining buckthorn	*Rhamnus frangula*	Forest
Common buckthorn	*Rhamnus cathartica*	Forest
Honeysuckles	*Lonicera sp.*	Open areas
Autumn olive	*Elaeagnus umbellate*	Open areas
Russian olive	*Elaeagnus augustifolia*	Open areas
Multiflora rose	*Rosa multiflora*	Open areas and edges
Goutweed	*Aegopodium podagraria*	Floodplains, riparian areas
Garlic mustard	*Alliaria petiolata*	Floodplains, disturbed woodlands, roadsides
Phragmites (common reed)	*Phragmites australis*	Wetlands

The features that make a plant invasive also frustrate efforts to control its expansion. Effective control requires the removal or killing of mature plants, but also requires that these removals be timed in such a way that they do not result in further reproduction and spread of the plant. Controls need to be designed around the morphology (form and structure), phenology (effects of climate on flowering and fruiting), and reproductive strategies of specific plants. For instance, while prescribed fire will reduce invasions of conifers in native grasslands, it tends to stimulate growth and reproduction of many other invasive plants. Control methods can be mechanical, biological or chemical:

- Mechanical controls include hand-pulling, girdling, mowing, mulching, tilling, and fire.
- Biological control involves the introduction of a natural enemy of an invasive plant. In most cases, the introduced enemy is itself a non-native species.
- Chemical control is often most efficient and effective, but carries risks of collateral damage to non-target species, as well as risks of water and soil contamination.

Given the biological characteristics of most of the problem plant species at the Ware River, the unpredictability of Division funding, and the moderate support by the public, eradication of well-established invasive plants from Division lands is an unrealistic goal, although control in priority areas is possible. Division staff are currently working to produce a strategic plan for managing invasive plants across the watershed system. Treatment of invasive plants to control or reverse their spread will progress as time and budget allow, from the highest to the lower priority areas.

Prioritizing which species to control and where to control them becomes critically important given the limited resources and personnel available. Therefore, areas will be selected for treatment as follows:

- Areas where invasive plant populations are recently established and limited in extent, so that control is a reasonable expectation.
- Areas of invasive plants that are presenting a direct threat to existing rare or endangered plants or animals. Control will be focused on the area of direct threat.
- Areas where tree regeneration is critical and is being prevented by one or more invasive plant species. This may include riparian zones and other critical protection areas.

7.5 Maintenance of Early-successional Habitat for Landscape Diversity

7.5.1 Importance of Early-successional Habitat

Large-scale historic changes in land use have dramatically impacted the number, type, and extent of open lands within the Ware River watershed. Early-successional habitat was a major component in the landscape prior to European settlement. Evidence suggests that grasslands existed in the Northeast before Europeans arrived, and grassland birds have been a component of avian diversity for a long time (Dettmers and Rosenberg 2000). Beaver activity, wildfires, windstorms, and fires set by Native Americans generated and maintained early-successional habitats.

By the 1800s, grasslands were even more abundant in the northeast as agricultural land dominated the landscape. Since the mid-1800s, the amount of grasslands and open fields has decreased dramatically, causing a similar decrease in many species of plants and animals that depend on open habitat. As farms were abandoned, the open fields and meadows were left undisturbed. Without frequent

disturbance such as mowing, burning, or grazing, those grasslands gradually reverted back to forest. In the process, some grassland species, such as the loggerhead shrike and regal fritillary butterfly, were significantly reduced in Massachusetts or even extirpated.

Today, farmland continues to be abandoned or converted to house lots, and the amount of viable open land habitat continues to shrink. The remaining grasslands, particularly large (>100 acres) or clustered fields, are increasingly important to a variety of wildlife. Eastern meadowlark, savanna sparrow, eastern bluebird, and bobolink all use hayfields, meadows, or pastures to forage and raise young. During the fall and winter, fields provide food for migrating sparrows, warblers, larks, and snow buntings. Raptors such as the northern harrier, short-eared owl, and American kestrel hunt in fields for small mammals (meadow voles, meadow jumping mice) and insects. White-tailed deer often graze in fields, and foxes hunt fields for small mammals or rabbits. Finally, butterflies like the monarch, tiger swallowtail, and various fritillaries feed on the nectar of grassland wildflowers.

Recent population trends for grassland-dependent species show alarming declines. Bobolinks and grasshopper sparrows have declined 38 and 69 percent, respectively in the last 25 years. Partners in Flight, a national conservation organization, has identified Neotropical migratory bird species of concern in Massachusetts. These species have a high perceived vulnerability (they may or may not be state or federally listed) and are critical to maintaining avifauna diversity in the state. Priority species include Henslow's sparrows, upland sandpipers, grasshopper sparrows, and bobolinks. These species are all associated with grassland habitat.

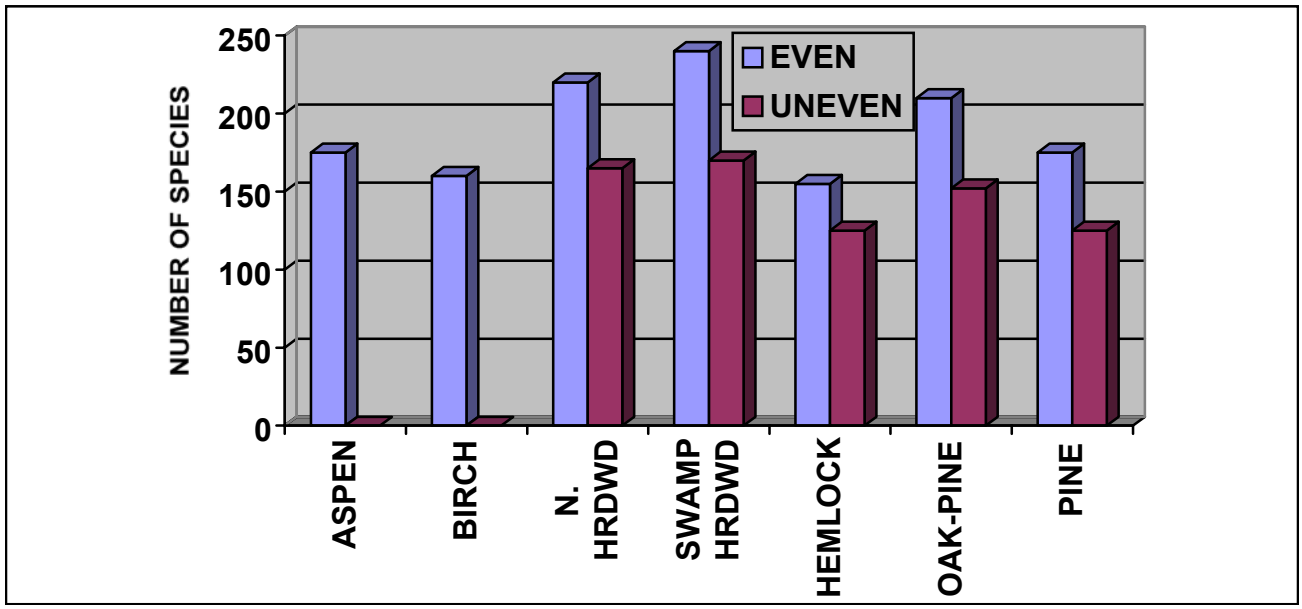
Early-successional forested habitat is also in decline in Massachusetts. Evidence suggests that early-successional forested habitat was present in sufficient amounts and distributed well enough across the landscape to support long-term populations of early-successional birds in the Northeast prior to either European or Native American intervention (Dettmers and Rosenberg 2000). Fire, major weather events, or beaver activity maintained or generated these habitats across the landscape. European and Native American populations increased the amount of early-successional forested habitat in the region. By the mid 1800s, forest cover in New England had dropped from >90% to <50% (Dettmers and Rosenberg, 2000). As farms were abandoned during the late 1800s, many fields started reverting to forests, and large amounts of early-successional forested habitat became available. Over time, these areas grew beyond the young seral stages used by early-successional species. A survey conducted in 1998 in Massachusetts concluded that only 4 percent of all available timberland was in a seedling-sapling stage (Trani, et al., 2001). Species dependent on these early-successional habitats have experienced further declines in recent decades as the amount of available habitat continues to shrink (Scanlon, 2000).

Partners in Flight has also identified species associated with early-successional forested habitat (e.g., blue-winged warbler, Eastern towhee, and prairie warbler) as high priority species. In addition, New England cottontails, bobcat, woodcock, and northern bobwhite have all experienced declines and are dependent on early-successional habitat (Hunter et al., 2001, Dessecker and McAuley 2001, Litvaitis 2001). Providing habitat for early-successional species involves considerations in both space and time. Early-successional habitats are temporary, generally lasting only 8-15 years. Therefore, either habitats need to be set back on a regular basis or new areas of early-successional habitat need to be created.

Even-aged forest management is the primary technique used to produce early-successional forest stands. This type of silviculture also provides the opportunity to regenerate shade-intolerant species such as aspen and birch. The resulting habitat provides distinct foraging and shelter opportunities for species that are not usually present in forest stands managed under an uneven-aged silvicultural system (DeGraaf et al., 1992). In addition, even-aged management appears to have little effect on mature forest species (Thompson and DeGraaf, 2001). According to DeGraaf, et al. (1992), even-aged management provides habitat for up to 26% more species than uneven-aged management in similar cover types (Fig. 13). Thus,

failure to incorporate some even-aged management techniques within the watershed could result in fewer wildlife species. Payne and Bryant (1994) also state that even-aged management tends to support more wildlife species than uneven-aged management in northern hardwoods, hemlock, oak-pine, and pine forests of the northeast. The current level of tree harvesting within the state is relatively light, widely dispersed, and generally does not provide substantial early-seral habitat. Where water supply protection does not preclude it, the Division will try to incorporate management techniques that meet primary management goals while creating this type of habitat. Utilizing a range or combination of silvicultural treatments can result in increased use by a wider variety of wildlife species (DeGraaf et al., 1992).

FIGURE 13: NUMBER OF WILDLIFE SPECIES BY SILVICULTURAL SYSTEM AND COVER-TYPE GROUP



Total number of amphibians, reptiles, birds and mammals using each cover type taken from DeGraaf, et al., 1992.
Even-aged: forests containing regeneration, sapling-pole, saw timber, and large saw timber stands in distance units of 5 acres or larger.
Uneven-aged: essentially continuous forest canopies and intermixed size and age classes produced by single-tree selection.

7.5.2 Early-successional Forested Habitat Management

Even-aged management techniques are used to create early-successional forested habitats. Even-aged techniques used on Division lands are done on stands where some regeneration is in place. Except for plantation removals, complete overstory removals greater than two acres in size are not practiced on Division land on the Ware River watershed. In larger cuts, typically 10-20% of the overstory is retained in clusters of 5-10 trees, with an average of 2-3 clusters per acre. These occasional clumps of trees are an attempt to mimic natural disturbances. Major catastrophic events typically don't completely remove the overstory in a given area, but instead create a patchy effect on the landscape as some trees survive the event. In addition, preserving clumps of trees allows the Division to selectively save valuable mast, den, and nest trees.

In order to create conditions favorable for some early-successional species, forest openings need to be large enough and placed appropriately to provide enough habitat to sustain viable animal populations over time. It would be counter-productive to create early-successional habitat that was too

small and isolated, preventing dispersal of the attracted species. As discussed in Section 5.10, forest management in Strategy Three areas will utilize even-aged management techniques to create openings up to ten acres in size, with retained structure in clumps of trees, as described above. Approximately thirty acres per year will be treated under this strategy, providing valuable early-successional forested habitat, while the vast majority of harvesting will follow uneven-aged methods. Topography, distance to tributaries, soils, stand health, and distance to human interface will be considered when planning limited even-aged management. The limited application of even-aged techniques provides opportunities to compare the effects of these larger openings on water supply protection to those of the more generally-applied uneven-aged management.

7.5.3 Early-successional Non-Forested Habitat Management Practices

7.5.3.1 Field Prioritization

The Division owns a variety of open lands. In most cases, these are either open lands the Division recently acquired through its land acquisition program or has traditionally managed in an open condition. To address the concern regarding declining field habitats, the Division will consider maintaining existing fields where doing so does not compromise water supply protection. Fields will be prioritized based on their size, distance to flowing water, relative isolation, and juxtaposition with other open fields. In general, very small (<2 acres), isolated fields will be abandoned and allowed to naturally regenerate to forest cover. In addition, those fields (or portions of fields) that border reservoir tributaries will also be abandoned and allowed to return to forest cover. This will provide an adequate forest buffer around flowing streams. Larger fields (>5 acres) that are isolated and not located near tributaries or otherwise critical to water supply protection will be maintained in their open condition through various management practices. Large (>20 acres) fields situated near (< 1 mile) or next to other fields and well-buffered from tributaries will be given top management priority, because these areas offer the greatest benefit to the conservation of regional biodiversity. Large clusters of open habitat may actually act as one unit, providing habitat for species that require large tracts of open land. These areas will be maintained or enhanced using a variety of management techniques in order to optimize the available habitat.

Following prioritization, those fields not abandoned will receive management to either maintain them in open habitat or to enhance the existing conditions. Management activities will be done by Division personnel, or through service contracts. Grasslands used for hay will be managed differently than those fields were hay production is not occurring. In both cases, wildlife considerations will be incorporated into the proposed management activities.

7.5.3.2 Non-Agricultural Grasslands

Approximately 75 acres of existing fields within the Ware River watershed are not suitable for hay production. While they are not mowed for hay, these fields still require active management in order to maintain them in a grassland condition. These non-agricultural fields present opportunities to apply various management techniques to enhance the existing habitat. The following management guidelines for mowing on lands not used for hay production will be followed:

- Mowing will be limited to not more than once annually and not less than once every three years. This will inhibit woody vegetation while allowing late-blooming wildflowers to develop.
- In years when fields are mowed, mowing will occur after August 1.

- Mower height will be a minimum of 8-10 inches off the ground to avoid impacts to habitat for small mammals and ground-nesting birds.
- Adjacent fields will be managed as one unit. Multiple contiguous fields will be managed through rotational mowing to provide a diversity of grassland types.

The Division owns several large contiguous grasslands that are potential candidates for other management activities. In addition, some smaller grasslands may also be suited to disturbances other than mowing. Burning grasslands can reduce buildup of dead vegetation, prevent the spread of woody vegetation, release nutrients into the soil, and rejuvenate plant growth. Hayfields can develop a thick layer of thatch that deters some nesting grassland birds and fire is an effective way of removing this. However, burning an area can eliminate some butterflies and moths and the newly burned area may be avoided by some bird species. If and when the Division conducts fire management of fields, the following guidelines will be followed.

- Burns will be conducted in early spring (mid-March to the end of April) after snowmelt but before bird nesting. Appropriate weather conditions should be considered.
- Grasslands will be burned once every 3-4 years, and an adjacent field will be left unburned for nesting birds during the burn year. Not more than thirty percent of the habitat will be burned during any year.
- If possible, on larger grasslands, only a portion of the area will be burned in any given year. Staggering burns allows for the development and availability of a variety of habitat conditions.

The quality of Division grasslands is variable. Encroaching exotic invasive plants are invading some fields. These plants typically crowd out native species and degrade the quality of the existing habitat. Most invasive plants are extremely vigorous and hardy and can be difficult to control. In some cases, it may be necessary to actively remove and control these species in order to optimize available grassland habitat. Multiflora rose, autumn olive, honeysuckle, and buckthorns have all been found on Division grasslands. Division staff are developing a strategic plan for addressing invasive plants.

7.5.3.3 Hay Fields

There are approximately seventy-five acres of grassland within the Ware River that could produce yearly hay crops. Most of these fields are relatively small (<twenty acres) and are distributed across the watershed. On these fields, the Division will try to establish service contracts with interested farmers for the right to harvest hay. These contracts will be similar to the forestry permits already issued by the Division. The contracts may last one year or span multiple years. Successful bidders would buy the rights to harvest hay from that particular field. Contracted fields will be subject to following restrictions in order to conserve grassland nesting birds and other wildlife:

- When feasible, cut the fields only once as late as possible, preferably after August 1 and before the first frost, but at a minimum, mowing should be delayed until late June.
- If some cutting must be done prior to late June, then cutting should occur in one of the following manners:
    - Set aside 50% of the field from cutting until late June. The unrestricted half can be cut anytime. Late season second cuttings can occur on either area at the farmer's discretion.
    - Alternatively, cut the whole field leaving uncut strips between cut areas. The uncut strips should be at least one tractor width wide. On small fields, cut from the outside in and leave the uncut half as a patch in the middle of the field.